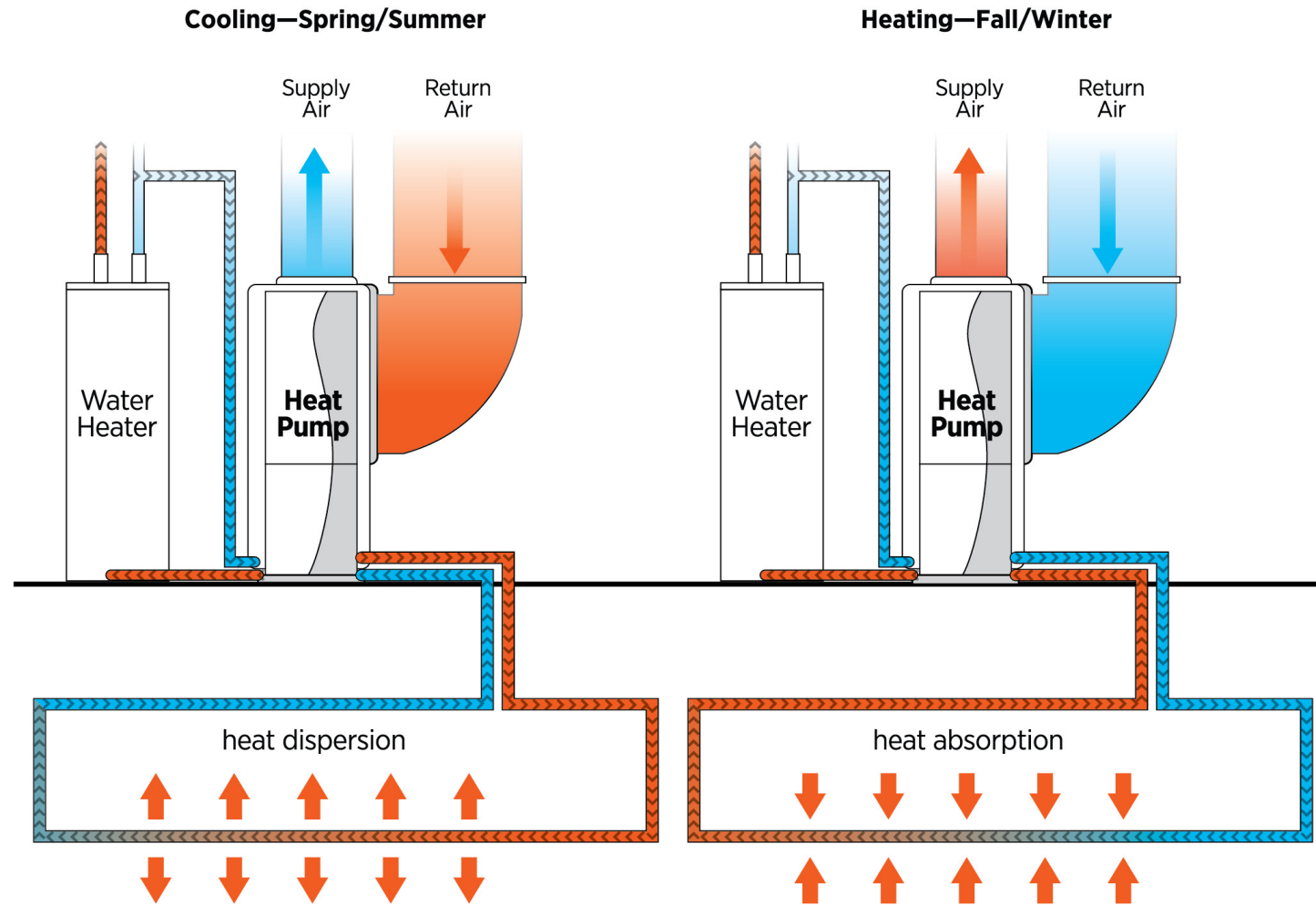


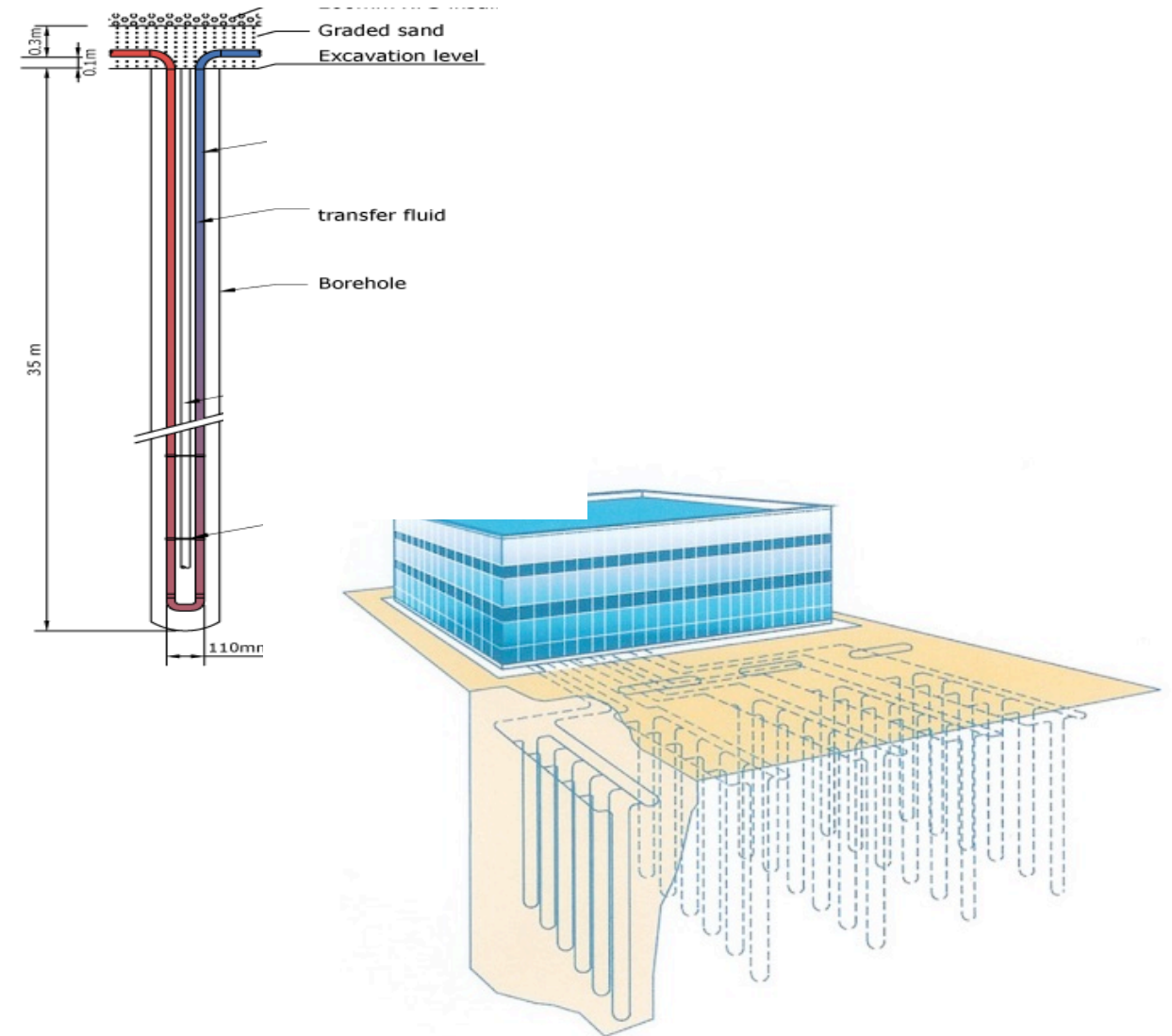
Geothermal Heat Pumps: Overview and Examples



Geothermal Low-Temperature Technology: Ground-Source Heat Pumps / Geothermal Heat Pumps



- Low-temperature, shallow systems
- Hundreds to thousands of boreholes connected to district energy stations
- Central loops distribute hot and cold water to buildings
- Major trends:
 - Replace existing district systems
 - Often hybrid systems
 - Buildings slowly retrofitted and added to system



Geothermal Heat Pump Use

- The **five leading countries** for installation (megawatts-thermal, MW_t) and use (terajoules/year, TJ/year) of geothermal heat pumps and annual energy use are China, the United States, Sweden, Germany, and Finland.
- An estimated **6.46 million GHP units are installed worldwide**, with the five leading countries accounting for 77.4% of these units.
- Annual global installed capacity of GHPs **grew 1.54 times**, at a compound rate of 9.06%, through 2019.
- GHP installations maintain approximately **3% annual growth in the United States**. About 40% of U.S. installations are residential; the remaining 60% are commercial or institutional.

Country	Installations (MW _t)	Use (TJ/year)
China	26,450	246,212
United States	20,230	145,460
Sweden	6,680	62,400
Germany	4,400	23,760
Finland	2,300	23,400

Sources: Lund, J.W. and Toth, A.N. “[Direct Utilization of Geothermal Energy 2020 Worldwide Review](#).” 2021. Prepared for World Geothermal Congress 2020+1. AND International Energy Administration. “[2020 United States Country Report](#).” IEA Geothermal, 2021.

Low-Temperature and Coproduced Resources

Community Geothermal Heating and Cooling Design and Deployment

This project will help communities implement technology that can reduce energy burden and fossil fuel dependence, increase grid resilience and stability, and improve environmental quality. The initiative also encourages innovative approaches to community-scale heating and cooling.

It aims to:

- Increase deployment
- Advance environmental justice
- Grow the workforce
- Share best practices
- Provide data and case studies.



Consider joining the Teaming Partner list: energy.gov/eere/geothermal/community-geothermal-design-and-deployment-teaming-list
Visit GTO's website to sign up for their newsletter:

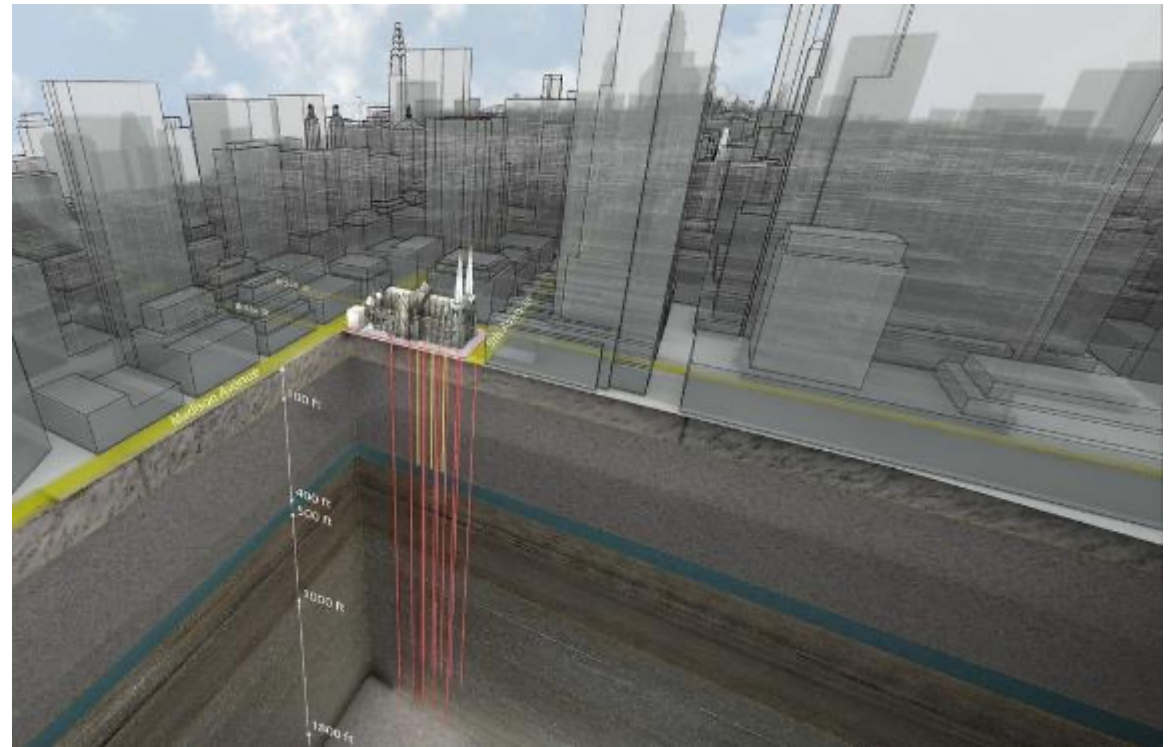
Large Building Geothermal Heat Pump Examples

SOURCE: Cornell Tech: <https://www.tech.cornell.edu/news/cornell-tech-on-path-to-reach-net-zero-at-the-bloomberg-center/>



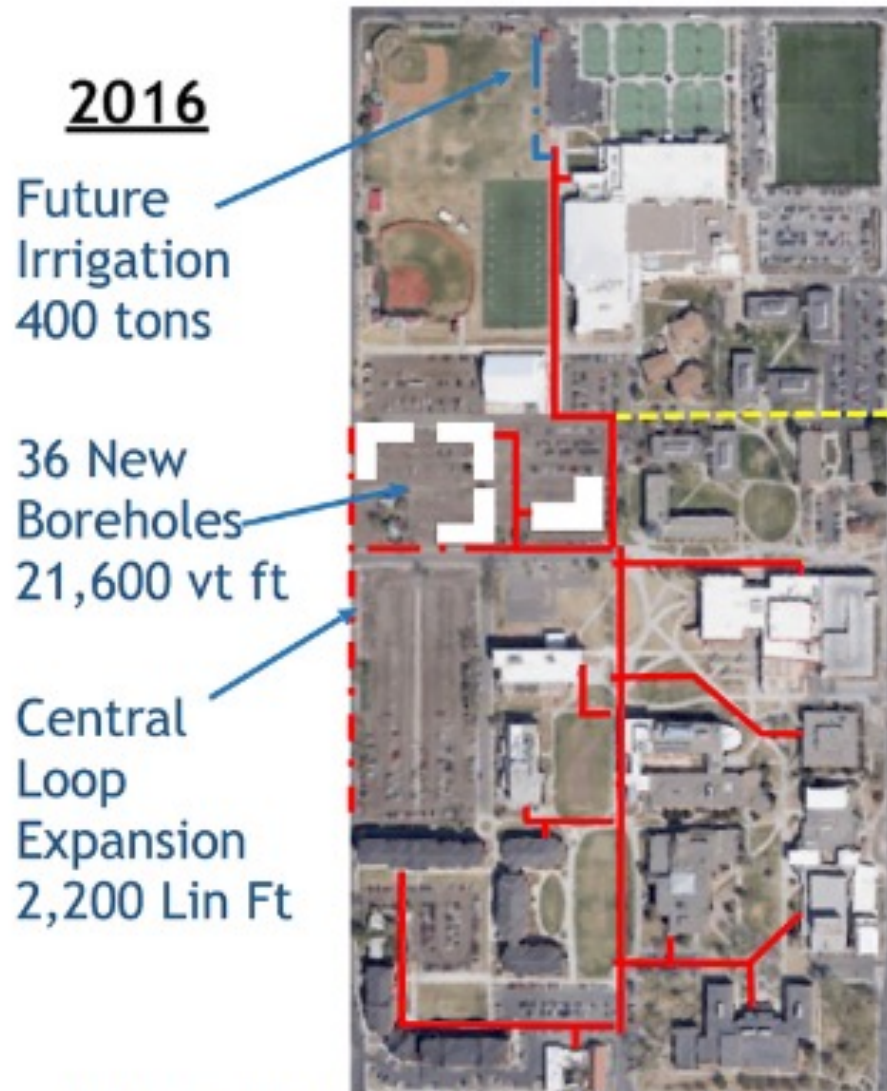
The **Emma and Georgina Bloomberg Center (Cornell University)** includes GHPs and other features for efficiency and low energy use. The geothermal system features 80 closed-loop geothermal wells, each 400 feet deep, were drilled below the main campus public open space. The electrically powered ground-source heat pumps are used to heat and cool the building in conjunction with an active chilled-beam system.

St. Patrick's Cathedral (New York City) uses a state-of-the-art geothermal heating and cooling system that eliminates the cost of burning 218 barrels of oil per year, thus reducing yearly costs and CO₂ emissions by 30%.



SOURCE: Dandelion Energy <https://dandelionenergy.com/st-patricks-cathedral-geothermal-heating-cooling>

District Heating and Cooling: Colorado Mesa University



Hybrid heat exchanger loop at Colorado Mesa U.

- System has been gradually expanded since 2006
- Heat pumps in individual buildings
- Total of 7 borefields distributed across campus
- Central distribution loop with water temperature between 50° and 85° F
- Supplemental boilers and chillers to maintain proper loop temperature

<https://www.coloradomesa.edu/facilities/sustainability/geo-systems.html>

<https://www.californiageo.org/geo-heat-pump-applications/hybrid-geothermal-heat-exchanger/>